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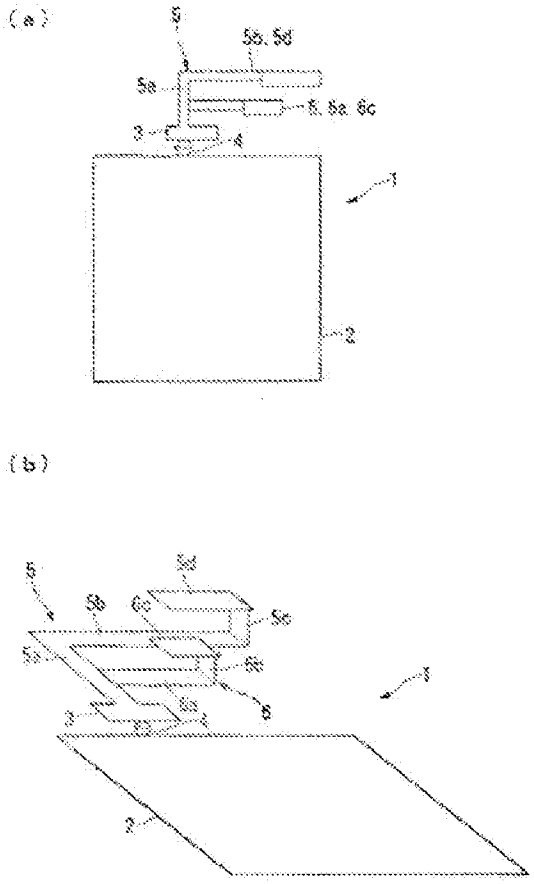
Abstract:
PROBLEM TO BE SOLVED: To provide a small-sized multi-frequency antenna which excellently operates in a plurality of frequency bands. SOLUTION: The present invention relates to a multi-frequency antenna including a ground plate, a matching plate connected to the ground plate via a power feeding point, and a first arm and a second arm extending from the matching plate, and being characterized in that a portion of at least one of the first arm and the second arm is formed in a meander shape, the first arm is constituted of four portions of first to fourth portions provided in order from the matching plate to a distal end side, the second arm is constituted of totally four portions of a shared portion that is the first portion of the first arm, and first to third portions provided in order from the shared portion to a distal end side, the second portion of the first arm and the fourth portion of the first arm face each other, the first portion of the second arm and the third portion of the second arm are arranged while facing each other, and the first arm and the second arm are provided in the same direction.



JPO Machine translation abstract:
(57)**Abstract**
SUBJECT Offer of the small multifrequency antenna which operates good in two or more frequency bands.
Means for Solution It has a cope plate, a matching board connected to this cope plate via the feeding point, and the 1st arm and the 2nd arm which extended from this matching board, A part of 1st arm and at least one 2nd arm are formed in the shape of a meander, and the 1st arm, Comprise four portions of the 1st portion - the 4th portion which were provided in order towards the tip side from a matching board, and the 2nd arm, Use the 1st portion of the 1st arm as a public

area, and it comprises a total of four portions of the 1st portion - the 3rd portion which were provided in order towards the tip side from this including this, A multifrequency antenna, wherein the 2nd portion of the 1st arm and the 4th portion of the 1st arm counter, and the 1st portion of the 2nd arm and the 3rd portion of the 2nd arm counter, and are arranged and the 1st arm and the 2nd arm are provided in the same direction.
Chosen drawing Drawing 1

Claim(s)
Claim 1
It has a cope plate, a matching board connected to this cope plate via the feeding point, and the 1st arm and the 2nd arm which extended from this matching board,
A part of 1st arm and at least one 2nd arm are formed in the shape of a meander,
The 1st arm comprises four portions of the 1st portion - the 4th portion which were provided in order towards the tip side from a matching board,
The 2nd arm uses the 1st portion of the 1st arm as a public area, and it comprises a total of four portions of the 1st portion - the 3rd portion which were provided in order towards the tip side from this including this,
The 2nd portion of the 1st arm and the 4th portion of the 1st arm counter, and the 1st portion of the 2nd arm and the 3rd portion of the 2nd arm counter, and are arranged,
And a multifrequency antenna, wherein the 1st arm and the 2nd arm are provided in the same direction.
Claim 2
The 1st arm is used for control with dominant mode by the side of a low frequency wave, and higher mode,
The 2nd arm is used for adjustment of dominant mode by the side of high frequency,
A bend line which divides each portion of the 1st arm and the 2nd arm adjusts an interval of each dominant mode and higher mode, and is set as a position which can control an interval of resonance frequency,
And the multifrequency antenna according to claim 1 setting up the size of each portion of the 1st arm and the 2nd arm able to add the low frequency wave side higher mode and dominant mode by the side of high frequency, and extending a zone by the side of high frequency be possible.
Claim 3
The multifrequency antenna according to claim 1 or 2, wherein a radiant element of an antenna comprises a 24.3mmx20mmx4mm size.
Claim 4
Frequency of f_{GSM} and GPS for frequency of GSM f_{GPS}, Frequency of f_{DCS} and PCS for frequency of DCS f_{PCS}, Make frequency of UMTS into f_{UMTS} and 880 MHz<=f_{GSM}<=960MHz, 1570 MHz<=f_{GPS}<=1580MHz, 1710 MHz<=f_{DCS}<=1785MHz, The multifrequency antenna according to any one of claims 1 to 3 characterized by being less than voltage standing wave ratio VSWR<=3.5 in 1850 MHz<=f_{PCS}<=1910MHz and 1920 MHz<=f_{UMTS}<=2170MHz.
Claim 5
Are a monopole versus an antenna and the length of gw and the 1st portion of the 1st arm for gL and cope plate width feedL, **cope plate length** When width of the 1st portion of the 1st arm is set to feedw, a size of these each part, The multifrequency antenna according to any one of claims 1 to 4 filling a relation (40 mm<=gL<=150mm, 30 mm<=gw<=60mm, 5 mm<=feedL<=40mm, and 0.1 mm<=feedw<=5mm).
Claim 6
It is a monopole versus an antenna,
2nd partial length GSMof 1st arm1L is 15 mm<=GSM1L<=30mm,
2nd partial width GSMof 1st arm1w is 0.5 mm<=GSM1w<=5mm,
3rd partial length GSMof 1st arm2L is 1 mm<=GSM2L<=10mm,
3rd partial width GSMof 1st arm2w is 0.5mmGSM2w<=5mm,

4th partial length GSMof 1st arm3L is 15 mm<=GSM3L<=30mm,
4th partial width GSMof 1st arm3w is 1 mm<=GSM3w<=10mm,
1st partial length DCSof 2nd arm1L is 10 mm<=DCS1L<=20mm,
1st partial width DCSof 2nd arm1w is 0.5 mm<=DCS1w<=5mm,
2nd partial length DCSof 2nd arm2L is 1 mm<=DCS2L<=10mm,
2nd partial width DCSof 2nd arm2w is 0.5 mm<=DCS2w<=5mm,
3rd partial length DCSof 2nd arm3L is 10 mm<=DCS3L<=20mm,
3rd partial width DCSof 2nd arm3w is 1 mm<=DCS3w<=10mm,
An antenna of claims 1-5 filling ******.

Claim 7

It is a monopole versus an antenna,
The 4th portion of the 1st arm is formed in the shape of a meander, and the line width slitGSM of this meander-like conductor 0 <=slitGSM<=1mm, The multifrequency antenna according to any one of claims 1 to 6 with which the interval spaceGSM of a meander-like conductor is characterized by filling a relation which is 0 <=spaceGSM<=1mm.

Detailed Description of the Invention

Field of the Invention

0001

This invention relates to the multifrequency common cellular-phone monopole antenna which uses meander structure especially about a multifrequency antenna suitable as antennas for field radios, such as a portable telephone which operates with two or more frequency bands, etc. The frequency bands of the purpose of the multifrequency antenna of this invention are GSM (920 MHz) / GPS (1575.42 MHz) / DCS (1795 MHz) / PCS (1920 MHz) / UMTS (2045 MHz), for example.

Background of the Invention

0002

Before, the thing of various methods is proposed as antennas for field radios, such as a portable telephone. For example, the flat-surface reverse F antenna is indicated by the nonpatent literatures 1 and 2. The helical antenna is indicated by the patent documents 1. The monopole antenna is indicated by the nonpatent literatures 3-6.

Nonpatent literature 1 K. Taga and "Analysis of. planar inverted-F antennas. and antenna design for. portable. radio. equipment, "Analysis, Design, and Measurement of Small and Low Profile Antennas, K. Hirasawa and M. Haneishi, Eds. Boston, MA: Artech, 1992, eh. 5.

Nonpatent literature 2 H. -J. Lee and S.-H. Cho, J. -K. Park Y.-H. Cho, J. -M. Kim and K-H. Lee, and J.-S. I.-Y. Lee. Kim and "The compact quad-band. planar iternal antenna for mobile handsets,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA, 2007, pp. 2045-2048.

Patent documents 1 JP,2003-37426,A

Nonpatent literature 3 K-L. Wong and "Very-low-profile monopoles for internal mobile phone antennas" Planar antenna for wireless. communications, Hoboken, New Jersey: John Wiley & Sons, 2003, ch. 3

Nonpatent literature 4 H. -C. Tung and T.-F. Chen, C. -Y. Chang and C.-Y. Lin, and T.-F. Huang and "Shorted. monopole antenna for. curved shape phone housing in clamshell phone,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA, 2007, pp. 1060-1063.

Nonpatent literature 5 Y. -W. Chi and K-L. Wong and "Printed dual-band. loop antenna for mobile phone application,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA,2007, pp. 3576-3579.

Nonpatent literature 6 H. Deng and Z. Feng, "A triple-band compact. monopole antenna for mobile handsets,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA, 2007,pp. 2069-2072.

Description of the Invention

Problem(s) to be Solved by the Invention

0003

Generally let the frequency bands which a cellular system uses be two or more frequency bands. For example, in the PDC method (Personal Digital Cellular telecommunication system) in Japan. Are using 800 MHz bands (810 to 956 MHz), and 1.4 GHz bands (1429 to 1501 MHz), and in the digital cellular system in the U.S. As an AMPS (Advanced Mobile Phone Service) method, 900 MHz bands

(824 to 894 MHz), 1.8 GHz bands (1850 to 1990 MHz) are used at least as a PCS (Personal Communication Service) method. In Europe, as a GSM (Global System for Mobile communications) method, a 900HMz belt (880 to 960 MHz), 1.8 GHz bands (1710 to 1880 MHz) are used as a DCS (Digital Cellular System) method. In addition, 2.0 GHz bands (1920 to 2170 MHz) are used as a UMTS (Universal Mobile Telecommunications System) method, and the 2.4GHz bandwidth (2400 to 2500 MHz) is used as a Bluetooth method. Thus, two or more frequency bands are used because use frequency runs short by the increase in a member in one frequency band.

0004

Thus, it is necessary to carry the antenna which operates with two or more frequency bands in field radios, such as a portable telephone which receives or transmits two or more frequency bands. Then, he was trying to build a flat antenna and the chip antenna of a snug product in the inside of a walkie-talkie case other than the main antennas conventionally as an antenna which operates on two or more frequency. However, in such a structure, the antenna took the volume inside a walkie-talkie case, and the miniaturization of a field radio had a problem that it was not suitable. When a user grasps a field radio, there is also a problem of the ratio with which the antenna to build in is covered by hand being large, and degrading the antenna characteristic at the time of field radio use.

0005

In order to realize the antenna which fills such a demand, 1 wavelength antenna for 4 minutes is leading. However, when using PIFA (Planar Inverted-Fantenna, reverse F flat antenna) which is indicated by the nonpatent literatures 1 and 2, the rise of the weight and size of the substrate for supporting an antenna, and a price poses a problem towards spread.

0006

When using the helical antenna currently indicated by the patent documents 1, the influence which asks a user decreases to some extent, but size is large and it is difficult to build in a field radio.

0007

Although the monopole antenna currently indicated by the nonpatent literatures 3-6 is a structure attractive as an antenna carried in a field radio with a thin shape, size is large and it is difficult to build in a field radio. In addition, the antenna which can cover two bands is proposed as indicated by the nonpatent literatures 3-5, but use frequency is insufficient in this case in a frequency band.

0008

This invention is made in view of said situation, and aims at offer of the small multifrequency antenna which operates good in two or more frequency bands.

Means for Solving the Problem

0009

In order to attain said purpose, this invention has a cope plate, a matching board connected to this cope plate via the feeding point, and the 1st arm and the 2nd arm which extended from this matching board,

A part of 1st arm and at least one 2nd arm are formed in the shape of a meander,

The 1st arm comprises four portions of the 1st portion - the 4th portion which were provided in order towards the tip side from a matching board,

The 2nd arm uses the 1st portion of the 1st arm as a public area, and it comprises a total of four portions of the 1st portion - the 3rd portion which were provided in order towards the tip side from this including this,

The 2nd portion of the 1st arm and the 4th portion of the 1st arm counter, and the 1st portion of the 2nd arm and the 3rd portion of the 2nd arm counter, and are arranged,

And a multifrequency antenna, wherein the 1st arm and the 2nd arm are provided in the same direction is provided.

0010

The 1st arm is used for control with dominant mode by the side of a low frequency wave, and higher mode in a multifrequency antenna of this invention,

The 2nd arm is used for adjustment of dominant mode by the side of high frequency,

A bend line which divides each portion of the 1st arm and the 2nd arm adjusts an interval of each dominant mode and higher mode, and is set as a position which can control an interval of resonance frequency,

And as for a size of each portion of the 1st arm and the 2nd arm, it is preferred to be set up it to

be possible to add the low frequency wave side higher mode and dominant mode by the side of high frequency, and to extend a zone by the side of high frequency be possible.

0011

In a multifrequency antenna of this invention, it is preferred that a radiant element of an antenna comprised a 24.3mmx20mmx4mm size.

0012

In a multifrequency antenna of this invention, frequency of GSM f_{GSM}, Frequency of f_{GPS} and DCS for frequency of GPS f_{DCS}, Frequency of f_{PCS} and UMTS is made into f_{UMTS} for frequency of PCS, 880 MHz<=f_{GSM}<=960MHz, 1570 MHz<=f_{GPS}<=1580MHz, In 1710 MHz<=f_{DCS}<=1785MHz, 1850 MHz<=f_{PCS}<=1910MHz, and 1920 MHz<=f_{UMTS}<=2170MHz, it is preferred that it is less than voltage standing wave ratio VSWR<=3.5.

0013

In a multifrequency antenna of this invention, are a monopole versus an antenna and cope plate length gL, When width of feedL and the 1st portion of the 1st arm is set **cope plate width** to feedw for the length of gw and the 1st portion of the 1st arm, It is preferred that a size of these each part fills a relation (40 mm<=gL<=150mm, 30 mm<=gw<=60mm, 5 mm<=feedL<=40mm, and 0.1 mm<=feedw<=5mm).

0014

In a multifrequency antenna of this invention, it is a monopole versus an antenna,
2nd partial length GSMof 1st arm1L is 15 mm<=GSM1L<=30mm,
2nd partial width GSMof 1st arm1w is 0.5 mm<=GSM1w<=5mm,
3rd partial length GSMof 1st arm2L is 1 mm<=GSM2L<=10mm,
3rd partial width GSMof 1st arm2w is 0.5mmGSM2w<=5mm,
4th partial length GSMof 1st arm3L is 15 mm<=GSM3L<=30mm,
4th partial width GSMof 1st arm3w is 1 mm<=GSM3w<=10mm,
1st partial length DCSof 2nd arm1L is 10 mm<=DCS1L<=20mm,
1st partial width DCSof 2nd arm1w is 0.5 mm<=DCS1w<=5mm,
2nd partial length DCSof 2nd arm2L is 1 mm<=DCS2L<=10mm,
2nd partial width DCSof 2nd arm2w is 0.5 mm<=DCS2w<=5mm,
3rd partial length DCSof 2nd arm3L is 10 mm<=DCS3L<=20mm,
3rd partial width DCSof 2nd arm3w is 1 mm<=DCS3w<=10mm,
It is preferred to fill ******.

0015

In a multifrequency antenna of this invention, it is a monopole versus an antenna,
It is preferred that the 4th portion of the 1st arm is formed in the shape of a meander, and the line width slitGSM of this meander-like conductor fills a relation whose interval spaceGSM of 0 <=slitGSM<=1mm and a meander-like conductor is 0 <=spaceGSM<=1mm.

Effect of the Invention

0016

The matching board by which the multifrequency antenna of this invention was connected to the cope plate and this cope plate via the feeding point, Have the 1st arm and the 2nd arm which extended from this matching board, and a part of 1st arm and at least one 2nd arm are formed in the shape of a meander, and the 1st arm, Comprise four portions of the 1st portion - the 4th portion which were provided in order towards the tip side from the matching board, and the 2nd arm, Use the 1st portion of the 1st arm as a public area, and it comprises a total of four portions of the 1st portion - the 3rd portion which were provided in order towards the tip side from this including this, Since it is what was considered as the composition with which the 2nd portion of the 1st arm and the 4th portion of the 1st arm counter, and the 1st portion of the 2nd arm and the 3rd portion of the 2nd arm counter, and are arranged, and the 1st arm and the 2nd arm are provided in the same direction, A miniaturization is possible and it becomes possible to have sufficient radiation property by a multifrequency zone.

Best Mode of Carrying Out the Invention

0017

Hereafter, the embodiment of this invention is described with reference to drawings.
Drawing 1 is a figure showing one embodiment of the multifrequency antenna of this invention,

drawing 1 (a) is a top view of the multifrequency antenna 1, and (b) is a perspective view. The numerals 1 a multifrequency antenna and 2 a cope plate and 3 among this figure A matching board, As for the feeding point and 5, the 1st portion of the 1st arm and 5b for 4 the 1st arm and 5a The 2nd portion of the 1st arm, As for the 2nd arm and 6a, the 2nd portion of the 2nd arm and 6c of the 1st portion of the 2nd arm and 6b are the 3rd portion of the 2nd arm the 4th portion of the 1st arm that 5c was formed in the 3rd portion of the 1st arm, and was formed in the shape of a meander 5 d, and 6.

0018

The matching board 3 by which the multifrequency antenna 1 of this embodiment was connected to the cope plate 2 and the cope plate 2 via the feeding point 4, It has the 1st arm 5 and the 2nd arm 6 which extended from this matching board 3, and a part of 1st arm 5 and at least one 2nd arm 6 (this illustration 5d of the 4th portion of the 1st arm) are formed in the shape of a meander. The 1st arm 5 comprises four **which were provided in order towards the tip side from the matching board 3 / the 1st portion - the 4th portion 5a-5d** portions, and the 2nd arm 6, The 1st portion 5a of the 1st arm is used as a public area, and it comprises a total of four portions of the 1st portion - the 3rd portion 6a-6c which were provided in order towards the tip side from this including this. The 2nd portion 5b of the 1st arm and 5 d of the 4th portion of the 1st arm counter among arm each portion, and the 1st portion 6a of the 2nd arm and the 3rd portion 6c of the 2nd arm counter, and are arranged, and are provided in the direction with same 1st arm 5 and 2nd arm 6. This multifrequency antenna 1 is constituted using the perfect conductor.

0019

In the multifrequency antenna 1 of this embodiment, the 1st arm 5 is used for control with the dominant mode by the side of a low frequency wave, and higher mode, and the 2nd arm 6 has the composition of being used for adjustment of the dominant mode by the side of high frequency. The bend line 7 which divides each portion of the 1st arm 5 and the 2nd arm 6, Adjust the interval of each dominant mode and higher mode, and it is set as the position which can control the interval of resonance frequency, and and the size of each portion of the 1st arm 5 and the 2nd arm 6, It is set up it to be possible to add the low frequency wave side higher mode and the dominant mode by the side of high frequency, and extending the zone by the side of high frequency be possible.

0020

In the multifrequency antenna 1 of this embodiment, the frequency of GSM f_{GSM}, The frequency of f_{GPS} and DCS for the frequency of GPS f_{DCS}, Frequency of f_{PCS} and UMTS is made into f_{UMTS} for the frequency of PCS, 880 MHz<=f_{GSM}<=960MHz, 1570 MHz<=f_{GPS}<=1580MHz, In 1710 MHz<=f_{DCS}<=1785MHz, 1850 MHz<=f_{PCS}<=1910MHz, and 1920 MHz<=f_{UMTS}<=2170MHz, it is preferred that it is less than voltage standing wave ratio VSWR<=3.5.

0021

The multifrequency antenna 1 of this embodiment is a monopole versus an antenna, The length of gw and the 1st portion of the 1st arm for gL and cope plate width feedL, **cope plate length** When width of the 1st portion of the 1st arm is set to feedw, it is preferred that the size of these each part fills a relation (40 mm<=gL<=150mm, 30 mm<=gw<=60mm, 5 mm<=feedL<=40mm, and 0.1 mm<=feedw<=5mm).

0022

In the multifrequency antenna 1 of this embodiment,
2nd partial length GSMof 1st arm1L is 15 mm<=GSM1L<=30mm,
2nd partial width GSMof 1st arm1w is 0.5 mm<=GSM1w<=5mm,
3rd partial length GSMof 1st arm2L is 1 mm<=GSM2L<=10mm,
3rd partial width GSMof 1st arm2w is 0.5mmGSM2w<=5mm,
4th partial length GSMof 1st arm3L is 15 mm<=GSM3L<=30mm,
4th partial width GSMof 1st arm3w is 1 mm<=GSM3w<=10mm,
1st partial length DCSof 2nd arm1L is 10 mm<=DCS1L<=20mm,
1st partial width DCSof 2nd arm1w is 0.5 mm<=DCS1w<=5mm,
2nd partial length DCSof 2nd arm2L is 1 mm<=DCS2L<=10mm,
2nd partial width DCSof 2nd arm2w is 0.5 mm<=DCS2w<=5mm,
3rd partial length DCSof 2nd arm3L is 10 mm<=DCS3L<=20mm,
3rd partial width DCSof 2nd arm3w is 1 mm<=DCS3w<=10mm,

It is preferred to fill ******.

0023

In the multifrequency antenna 1 of this embodiment, it is preferred that 5 d of the 4th portion of the 1st arm is formed in the shape of a meander, and the line width slitGSM of this meander-like conductor fills the relation whose interval spaceGSM of 0 <=slitGSM<=1mm and a meander-like conductor is 0 <=spaceGSM<=1mm.

0024

It is using the two arms 5 and 6, and the multifrequency antenna 1 of this embodiment can generate 2 resonance, it is using the matching board 3 and can extend the zone by the side of high frequency.

0025

Using the 1st arm 5, the multifrequency antenna 1 of this embodiment controls the dominant mode and higher mode by the side of a low frequency wave, and it becomes possible to adjust the dominant mode by the side of high frequency by using the 2nd arm 6. It is a position of the bend line 7 of the 1st arm 5 and the 2nd arm 6, and the interval of each dominant mode and higher mode can be adjusted, and it is possible to control the interval of resonance frequency. By using those two arms 5 and 6, it is possible to add the higher mode by the side of a low frequency wave and the dominant mode by the side of high frequency, and the zone by the side of high frequency can be extended. It does not care about changing the position of the 1st arm 5 and the 2nd arm 6.

0026

Since one fourth generally used for the miniaturized antenna of the wavelength of arm length is too large, in the multifrequency antenna 1 of this embodiment, the antenna is miniaturized by having used meander structure for 5 d of the 4th portion of the 1st antenna.

Example

0027

The multifrequency antenna (it is hereafter written as an antenna.) shown in drawing 2 was produced. The important section enlarged drawing with which drawing 2 (a) expresses the perspective view of an antenna, and (b) expresses each part of an arm, and (c) are the top views in the state where each arm was developed. The antenna produced by this example is the same structure as the antenna 1 of drawing 1 mentioned above.
Identical codes are given to the same component.

0028

The whole size of the antenna of this example is 24.3mmx20mmx4mm. The size of the used cope plate 2 was set to gL=70 mmxgw=40mm of a value typical as a portable telephone. A detailed size is summarized in Table 1 and described.

0029

Table 1

For drawings please refer to the original document.

0030

The characteristic of the produced antenna was investigated using the above parameter. Drawing 3 shows an S parameter. This figure shows that 2 resonance is performed in GSM900 of a frequency band and the band (DCS, PCS, UMTS) of 3G which are made into the purpose expressed with the wavy line. If the standard of VSWR<3.5 is assumed, the bandwidth of 900 MHz bands (920-MHz center) and the band (it is a 1920-MHz center here) of 3G will be 87.3 MHz and 856.2 MHz, respectively. A detailed result is summarized in Table 2 and described.

0031

Table 2

For drawings please refer to the original document.

0032
Drawing 4 expresses the matching states of an antenna. From this figure, resistance (925 MHz and 1995 MHz) and a reactance, respectively $R_{in925MHz}$=40.29ohm, It turns out that they are $R_{in1995MHz}$=66.64ohm, $X_{in925MHz}$=2.16ohm, and $X_{in1995MHz}$=1.52ohm.
0033
Drawing 5 (a) - (e) shows the radiation property (inside of a vertical plane) of an antenna in yz flat surface of this antenna, and drawing 6 (a) - (e) shows the radiation property (inside of the level surface) of an antenna in the xy plane of an antenna. The frequency of the value from which the S parameter has fallen most shows the radiation property of an antenna.
The peak gain values in each zone acquired from the result of drawing 5 are summarized in Table 3, and are described.
0034
Table 3

For drawings please refer to the original document.

0035
The result of drawing 5, drawing 6, and Table 3 shows that this antenna is available by each zone of GSM (920 MHz) / GPS (1575.42 MHz) / DCS (1795 MHz) / PCS (1920 MHz) / UMTS (2045 MHz).

Drawing 6 shows that the antenna of this example has the near characteristic of a monopole.
Brief Description of the Drawings
0036
Drawing 1 The embodiment of the multifrequency antenna of this invention is shown, (a) is a top view of a multifrequency antenna and (b) is a perspective view.
Drawing 2 The important section enlarged drawing with which the multifrequency antenna produced in the example concerning this invention is shown, (a) expresses the perspective view of an antenna and (b) expresses each part of an arm, and (c) are the top views in the state where each arm was developed.
Drawing 3 He is Graf who shows the S parameter of the antenna of an example.
Drawing 4 He is Graf showing the matching states of the antenna of an example.
Drawing 5 In yz flat surface of this antenna, it is a graph which shows the radiation property (inside of a vertical plane) of an antenna.
Drawing 6 In the xy plane of an antenna, it is a graph which shows the radiation property (inside of the level surface) of an antenna.
Description of Notations
0037
1 -- **The feeding point, 5 / -- The 1st arm,** -- A multifrequency antenna, 2 -- A cope plate, 3 -- A matching board, 4 5a **-- The 4th portion of the 1st arm, 6 / -- The 2nd arm, 6a / -- The 1st portion of the 2nd arm, 6b / -- The 2nd portion of the 2nd arm, 6c / -- The 3rd portion of the 2nd arm, 7 / -- Send line.** -- The 1st portion of the 1st arm, 5b -- The 2nd portion of the 1st arm, 5c -- The 3rd portion of the 1st arm, 5d

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Field of the Invention
0001
This invention relates to the multifrequency common cellular-phone monopole antenna which uses meander structure especially about a multifrequency antenna suitable as antennas for field radios, such as a portable telephone which operates with two or more frequency bands, etc. The frequency bands of the purpose of the multifrequency antenna of this invention are GSM (920 MHz) / GPS

(1575.42 MHz) / DCS (1795 MHz) / PCS (1920 MHz) / UMTS (2045 MHz), for example.

Background of the Invention

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Before, the thing of various methods is proposed as antennas for field radios, such as a portable telephone. For example, the flat-surface reverse F antenna is indicated by the nonpatent literatures 1 and 2. The helical antenna is indicated by the patent documents 1. The monopole antenna is indicated by the nonpatent literatures 3-6.

Nonpatent literature 1 K. Taga and "Analysis of. planar inverted-F antennas. and antenna design for. portable. radio. equipment, "Analysis, Design, and Measurement of Small and Low Profile Antennas, K. Hirasawa and M. Haneishi, Eds. Boston, MA: Artech, 1992, eh. 5.

Nonpatent literature 2 H. -J. Lee and S.-H. Cho, J. -K. Park Y.-H. Cho, J. -M. Kim and K-H. Lee, and J.-S. I.-Y. Lee. Kim and "The compact quad-band. planar iternal antenna for mobile handsets,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA, 2007, pp. 2045-2048.

Patent documents 1 JP,2003-37426,A

Nonpatent literature 3 K-L. Wong and "Very-low-profile monopoles for internal mobile phone antennas" Planar antenna for wireless. communications, Hoboken, New Jersey: John Wiley & Sons, 2003, ch. 3

Nonpatent literature 4 H. -C. Tung and T.-F. Chen, C. -Y. Chang and C.-Y. Lin, and T.-F. Huang and "Shorted. monopole antenna for. curved shape phone housing in clamshell phone,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA, 2007, pp. 1060-1063.

Nonpatent literature 5 Y. -W. Chi and K-L. Wong and "Printed dual-band. loop antenna for mobile phone application,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA,2007, pp. 3576-3579.

Nonpatent literature 6 H. Deng and Z. Feng, "A triple-band compact. monopole antenna for mobile handsets,"in Proc. IEEE Antennas Propag. Int. Symp., Hawai, USA, 2007,pp. 2069-2072.

Effect of the Invention

0016

The matching board by which the multifrequency antenna of this invention was connected to the cope plate and this cope plate via the feeding point, Have the 1st arm and the 2nd arm which extended from this matching board, and a part of 1st arm and at least one 2nd arm are formed in the shape of a meander, and the 1st arm, Comprise four portions of the 1st portion - the 4th portion which were provided in order towards the tip side from the matching board, and the 2nd arm, Use the 1st portion of the 1st arm as a public area, and it comprises a total of four portions of the 1st portion - the 3rd portion which were provided in order towards the tip side from this including this, Since it is what was considered as the composition with which the 2nd portion of the 1st arm and the 4th portion of the 1st arm counter, and the 1st portion of the 2nd arm and the 3rd portion of the 2nd arm counter, and are arranged, and the 1st arm and the 2nd arm are provided in the same direction, A miniaturization is possible and it becomes possible to have sufficient radiation property by a multifrequency zone.

Example

0027

The multifrequency antenna (it is hereafter written as an antenna.) shown in drawing 2 was produced. The important section enlarged drawing with which drawing 2 (a) expresses the perspective view of an antenna, and (b) expresses each part of an arm, and (c) are the top views in the state where each arm was developed. The antenna produced by this example is the same structure as the antenna 1 of drawing 1 mentioned above.

Identical codes are given to the same component.

0028
The whole size of the antenna of this example is 24.3mmx20mmx4mm. The size of the used cope plate 2 was set to gL=70 mmxgw=40mm of a value typical as a portable telephone. A detailed size is summarized in Table 1 and described.
0029
Table 1

For drawings please refer to the original document.

0030
The characteristic of the produced antenna was investigated using the above parameter. Drawing 3 shows an S parameter. This figure shows that 2 resonance is performed in GSM900 of a frequency band and the band (DCS, PCS, UMTS) of 3G which are made into the purpose expressed with the wavy line. If the standard of VSWR<3.5 is assumed, the bandwidth of 900 MHz bands (920-MHz center) and the band (it is a 1920-MHz center here) of 3G will be 87.3 MHz and 856.2 MHz, respectively. A detailed result is summarized in Table 2 and described.
0031
Table 2

For drawings please refer to the original document.

0032
Drawing 4 expresses the matching states of an antenna. From this figure, resistance (925 MHz and 1995 MHz) and a reactance, respectively $R_{in925MHz}$=40.29ohm, It turns out that they are $R_{in1995MHz}$=66.64ohm, $X_{in925MHz}$=2.16ohm, and $X_{in1995MHz}$=1.52ohm.
0033
Drawing 5 (a) - (e) shows the radiation property (inside of a vertical plane) of an antenna in yz flat surface of this antenna, and drawing 6 (a) - (e) shows the radiation property (inside of the level surface) of an antenna in the xy plane of an antenna. The frequency of the value from which the S parameter has fallen most shows the radiation property of an antenna.
The peak gain values in each zone acquired from the result of drawing 5 are summarized in Table 3, and are described.
0034
Table 3

For drawings please refer to the original document.

0035
The result of drawing 5, drawing 6, and Table 3 shows that this antenna is available by each zone of GSM (920 MHz) / GPS (1575.42 MHz) / DCS (1795 MHz) / PCS (1920 MHz) / UMTS (2045 MHz).

Drawing 6 shows that the antenna of this example has the near characteristic of a monopole.

Problem(s) to be Solved by the Invention
0003
Generally let the frequency bands which a cellular system uses be two or more frequency bands. For example, in the PDC method (Personal Digital Cellular telecommunication system) in Japan. Are

using 800 MHz bands (810 to 956 MHz), and 1.4 GHz bands (1429 to 1501 MHz), and in the digital cellular system in the U.S. As an AMPS (Advanced Mobile Phone Service) method, 900 MHz bands (824 to 894 MHz), 1.8 GHz bands (1850 to 1990 MHz) are used at least as a PCS (Personal Communication Service) method. In Europe, as a GSM (Global System for Mobile communications) method, a 900HMz belt (880 to 960 MHz), 1.8 GHz bands (1710 to 1880 MHz) are used as a DCS (Digital Cellular System) method. In addition, 2.0 GHz bands (1920 to 2170 MHz) are used as a UMTS (Universal Mobile Telecommunications System) method, and the 2.4GHz bandwidth (2400 to 2500 MHz) is used as a Bluetooth method. Thus, two or more frequency bands are used because use frequency runs short by the increase in a member in one frequency band.

0004

Thus, it is necessary to carry the antenna which operates with two or more frequency bands in field radios, such as a portable telephone which receives or transmits two or more frequency bands. Then, he was trying to build a flat antenna and the chip antenna of a snug product in the inside of a walkie-talkie case other than the main antennas conventionally as an antenna which operates on two or more frequency. However, in such a structure, the antenna took the volume inside a walkie-talkie case, and the miniaturization of a field radio had a problem that it was not suitable. When a user grasps a field radio, there is also a problem of the ratio with which the antenna to build in is covered by hand being large, and degrading the antenna characteristic at the time of field radio use.

0005

In order to realize the antenna which fills such a demand, 1 wavelength antenna for 4 minutes is leading. However, when using PIFA (Planar Inverted-Fantenna, reverse F flat antenna) which is indicated by the nonpatent literatures 1 and 2, the rise of the weight and size of the substrate for supporting an antenna, and a price poses a problem towards spread.

0006

When using the helical antenna currently indicated by the patent documents 1, the influence which asks a user decreases to some extent, but size is large and it is difficult to build in a field radio.

0007

Although the monopole antenna currently indicated by the nonpatent literatures 3-6 is a structure attractive as an antenna carried in a field radio with a thin shape, size is large and it is difficult to build in a field radio. In addition, the antenna which can cover two bands is proposed as indicated by the nonpatent literatures 3-5, but use frequency is insufficient in this case in a frequency band.

0008

This invention is made in view of said situation, and aims at offer of the small multifrequency antenna which operates good in two or more frequency bands.

Means for Solving the Problem

0009

In order to attain said purpose, this invention has a cope plate, a matching board connected to this cope plate via the feeding point, and the 1st arm and the 2nd arm which extended from this matching board,

A part of 1st arm and at least one 2nd arm are formed in the shape of a meander,

The 1st arm comprises four portions of the 1st portion - the 4th portion which were provided in order towards the tip side from a matching board,

The 2nd arm uses the 1st portion of the 1st arm as a public area, and it comprises a total of four portions of the 1st portion - the 3rd portion which were provided in order towards the tip side from this including this,

The 2nd portion of the 1st arm and the 4th portion of the 1st arm counter, and the 1st portion of the 2nd arm and the 3rd portion of the 2nd arm counter, and are arranged,

And a multifrequency antenna, wherein the 1st arm and the 2nd arm are provided in the same direction is provided.

0010

The 1st arm is used for control with dominant mode by the side of a low frequency wave, and higher mode in a multifrequency antenna of this invention,

The 2nd arm is used for adjustment of dominant mode by the side of high frequency,
A bend line which divides each portion of the 1st arm and the 2nd arm adjusts an interval of each dominant mode and higher mode, and is set as a position which can control an interval of resonance frequency,
And as for a size of each portion of the 1st arm and the 2nd arm, it is preferred to be set up it to be possible to add the low frequency wave side higher mode and dominant mode by the side of high frequency, and to extend a zone by the side of high frequency be possible.

0011

In a multifrequency antenna of this invention, it is preferred that a radiant element of an antenna comprised a 24.3mmx20mmx4mm size.

0012

In a multifrequency antenna of this invention, frequency of GSM f_{GSM}, Frequency of f_{GPS} and DCS for frequency of GPS f_{DCS}, Frequency of f_{PCS} and UMTS is made into f_{UMTS} for frequency of PCS, 880 MHz<=f_{GSM}<=960MHz, 1570 MHz<=f_{GPS}<=1580MHz, In 1710 MHz<=f_{DCS}<=1785MHz, 1850 MHz<=f_{PCS}<=1910MHz, and 1920 MHz<=f_{UMTS}<=2170MHz, it is preferred that it is less than voltage standing wave ratio VSWR<=3.5.

0013

In a multifrequency antenna of this invention, are a monopole versus an antenna and cope plate length gL, When width of feedL and the 1st portion of the 1st arm is set **cope plate width** to feedw for the length of gw and the 1st portion of the 1st arm, It is preferred that a size of these each part fills a relation (40 mm<=gL<=150mm, 30 mm<=gw<=60mm, 5 mm<=feedL<=40mm, and 0.1 mm<=feedw<=5mm).

0014

In a multifrequency antenna of this invention, it is a monopole versus an antenna,
2nd partial length GSMof 1st arm1L is 15 mm<=GSM1L<=30mm,
2nd partial width GSMof 1st arm1w is 0.5 mm<=GSM1w<=5mm,
3rd partial length GSMof 1st arm2L is 1 mm<=GSM2L<=10mm,
3rd partial width GSMof 1st arm2w is 0.5mmGSM2w<=5mm,
4th partial length GSMof 1st arm3L is 15 mm<=GSM3L<=30mm,
4th partial width GSMof 1st arm3w is 1 mm<=GSM3w<=10mm,
1st partial length DCSof 2nd arm1L is 10 mm<=DCS1L<=20mm,
1st partial width DCSof 2nd arm1w is 0.5 mm<=DCS1w<=5mm,
2nd partial length DCSof 2nd arm2L is 1 mm<=DCS2L<=10mm,
2nd partial width DCSof 2nd arm2w is 0.5 mm<=DCS2w<=5mm,
3rd partial length DCSof 2nd arm3L is 10 mm<=DCS3L<=20mm,
3rd partial width DCSof 2nd arm3w is 1 mm<=DCS3w<=10mm,
It is preferred to fill ******.

0015

In a multifrequency antenna of this invention, it is a monopole versus an antenna,
It is preferred that the 4th portion of the 1st arm is formed in the shape of a meander, and the line width slitGSM of this meander-like conductor fills a relation whose interval spaceGSM of 0 <=slitGSM<=1mm and a meander-like conductor is 0 <=spaceGSM<=1mm.

Brief Description of the Drawings

0036

Drawing 1 The embodiment of the multifrequency antenna of this invention is shown, (a) is a top view of a multifrequency antenna and (b) is a perspective view.
Drawing 2 The important section enlarged drawing with which the multifrequency antenna produced in the example concerning this invention is shown, (a) expresses the perspective view of an antenna and (b) expresses each part of an arm, and (c) are the top views in the state where each arm was developed.
Drawing 3 It is a graph which shows the S parameter of the antenna of an example.
Drawing 4 It is a graph showing the matching states of the antenna of an example.

Drawing 5 In yz flat surface of this antenna, it is a graph which shows the radiation property (inside of a vertical plane) of an antenna.
Drawing 6 In the xy plane of an antenna, it is a graph which shows the radiation property (inside of the level surface) of an antenna.

Drawing 1

For drawings please refer to the original document.

Drawing 2

For drawings please refer to the original document.

Drawing 3

For drawings please refer to the original document.

Drawing 4

For drawings please refer to the original document.

Drawing 5

For drawings please refer to the original document.

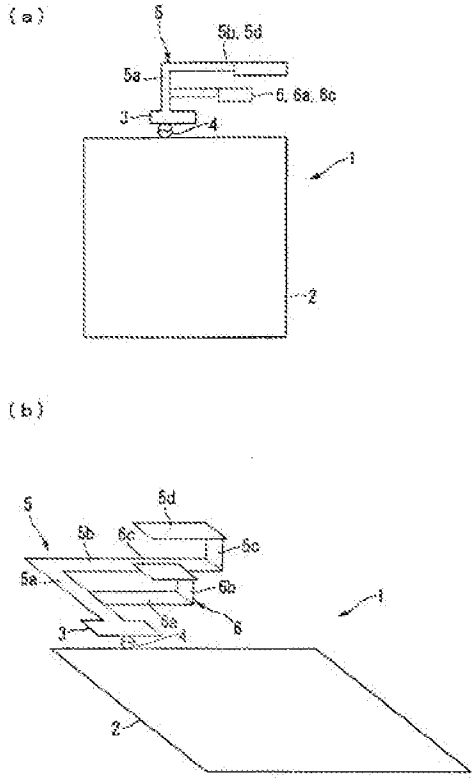
Drawing 6

For drawings please refer to the original document.

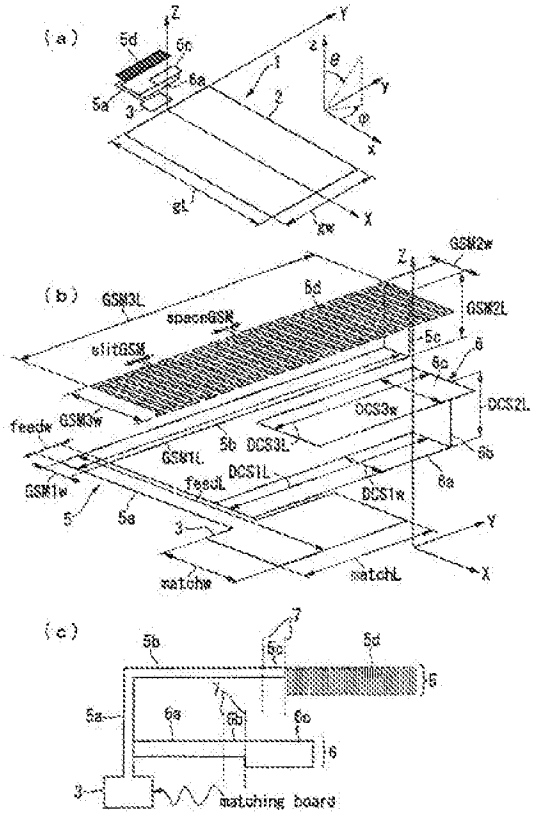
For drawings please refer to the original document.

図、（ｂ）はアーム各部を表す要部拡大図、（ｃ）は各アームを展開した状態の平面図である。
【図3】実施例のアンテナのＳパラメータを示すグラフである。
【図4】実施例のアンテナの整合状態を表すグラフである。
【図5】このアンテナのｙｚ平面において、アンテナの（垂直面内の）放射特性を示すグラフである。
【図6】アンテナのｘｙ平面において、アンテナの（水平面内の）放射特性を示すグラフである。
【符号の説明】
【0037】
１…多周波アンテナ、２…地板、３…マッチング板、４…給電点、５…第１アーム、５ａ…第１アーム第１部分、５ｂ…第１アーム第２部分、５ｃ…第１アーム第３部分、５ｄ…第１アーム第４部分、６…第２アーム、６ａ…第２アーム第１部分、６ｂ…第２アーム第２部分、６ｃ…第２アーム第３部分、７…折り曲げ線。

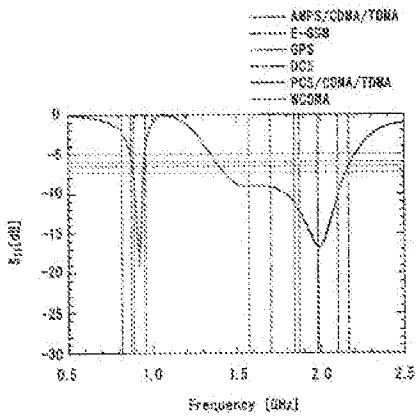
【図1】



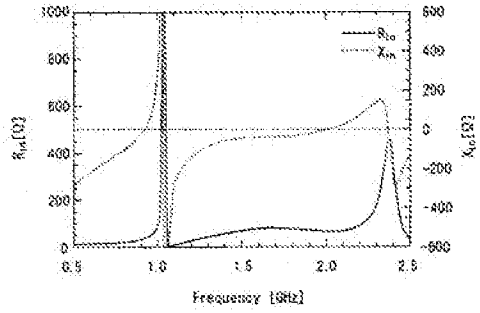
【図2】



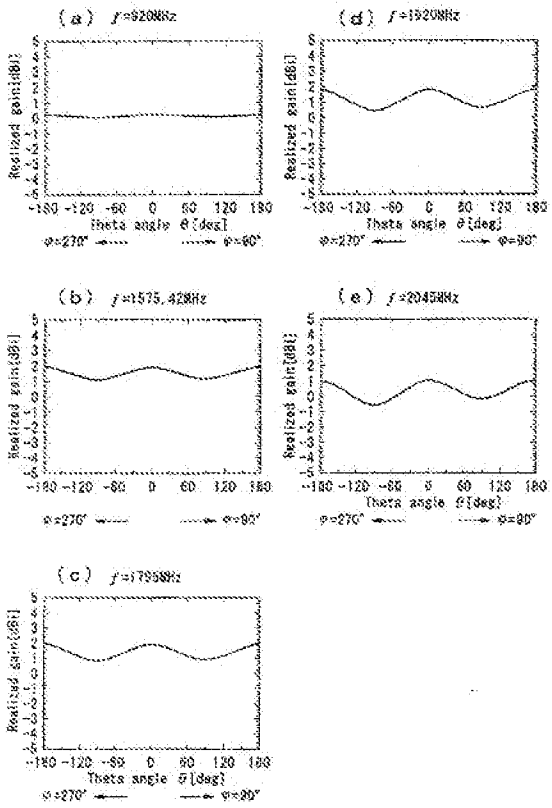
【図3】


AMPS/CDMA/TDMA
E-GSM
GPS
DCS
PCS/CDMA/TDMA
WCDMA
Frequency [GHz]

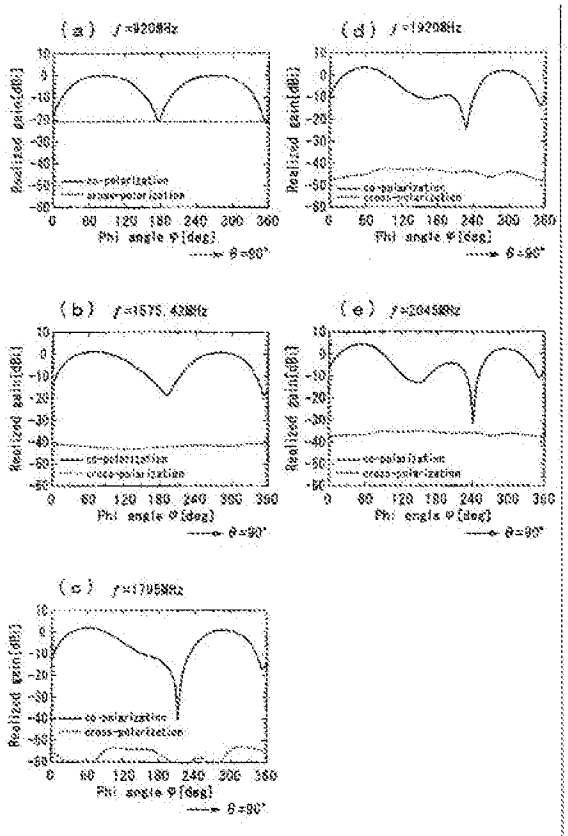
【図4】


Frequency [GHz]

【図5】


(a) f=920MHz
(d) f=1920MHz
(b) f=1575.42MHz
(e) f=2045MHz
(c) f=1795MHz
Realized gain[dBi]
Theta angle θ[deg]
φ=270°
φ=90°

【図6】


(a) f=920MHz
(d) f=1920MHz
(b) f=1575.42MHz
(e) f=2045MHz
(c) f=1795MHz
Realized gain[dBi]
co-polarization
cross-polarization
Phi angle φ[deg]
θ=90°